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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/706,034	11/13/2003	Kiyotaka Miyano	04329.3181	6028

7590 12/01/2004  
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EXAMINER

DANG, TRUNG Q

ART UNIT PAPER NUMBER

2823

DATE MAILED: 12/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/706,034	MIYANO, KIYOTAKA	
	<b>Examiner</b>	<b>Art Unit</b>	
	Trung Dang	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 9/9/04.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 1-4 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 5-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 November 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)               | Paper No(s)/Mail Date. _____  |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>11/13/03</u> .  | 6) <input type="checkbox"/> Other: _____                                    |

**DETAILED ACTION**

***Election/Restrictions***

1. Applicant's election without traverse of claims 5-20 in the reply filed on 09/09/04 is acknowledged.

***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim 20 rejected under 35 U.S.C. 102(b) as being anticipated by Ast et al.  
(US 5,516,724).

With reference to Figs. 2-3, the reference anticipates the claim in that it discloses a method of manufacturing a semiconductor device, comprising:

forming a SiGe conductive film 14 made of a first semiconductor (Si) and a second semiconductor (Ge) on an insulating film formed on a semiconductor substrate (Fig. 2 and col. 6, lines 4-16);

thermally oxidizing the conductive film in an atmosphere in which the first semiconductor is oxidized and the second semiconductor is not oxidized, to form silicon oxide film 17 made of the first semiconductor on the conductive film (Fig. 3 and col. 7, lines 47-65).

*Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 10-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohuchi (US 6,762,468) in view of Ast et al. cited above and Bar-Gadda (US 6,579,805).

With reference to Fig. 6, the Ohuchi teaches method of manufacturing a semiconductor device comprising:

forming source/drain regions **20** formed in a semiconductor substrate;  
forming a gate insulating film **6a** on a channel region between the source/drain regions;  
forming a gate electrode **8a** made of SiGe on the gate insulating film (col. 4, lines 32-35); and  
thermally oxidizing the gate electrode in an oxidation condition such that silicon in the SiGe gate electrode is selectively oxidized to form oxide sidewalls **12** (col. 4, lines 45-48).

Ohuchi differs from the claims in not disclosing that the oxidation

atmosphere contains an oxidant for selectively oxidizing Si and a reductant for reducing Ge.

Ast teaches a process in which a SiGe layer is oxidized in steam such that Si in the SiGe layer is selectively oxidized to form silicon dioxide while Ge in the SiGe layer is not oxidized (col. 5, lines 19-25; col. 6, lines 8-13; col. 4, lines 28-30; col. 8, line 50).

It would have been obvious to one having ordinary skill in the art to oxidize the SiGe gate electrode 8a in steam as suggested by Ast because the oxidation condition set forth by Ohuchi such that silicon in the SiGe gate electrode is selectively oxidized is known in the art, and the application of a known process to achieve a desired result would have been within the level of one skilled in the art. Furthermore, Bar-Gadda discloses that steam for use in an oxidation process for producing silicon dioxide is generated by admitting H<sub>2</sub> and O<sub>2</sub> into an oxidation chamber and the H<sub>2</sub> and O<sub>2</sub> react to form steam in close proximity to the semiconductor wafer (col. 2, lines 30-39). In light of the fact shown by Bar-Gadda, it is therefore believed that H<sub>2</sub> is still present in steam to some extent because not all H<sub>2</sub> takes place in the reaction to form H<sub>2</sub>O. This fact is manifested by the result (silicon is oxidized while germanium is not) obtained in Ast's oxidation atmosphere of steam, which result is identical to that of disclosed in the pending specification. Therefore, absent evident to the contrary, Ast's oxidation atmosphere contains an oxidant (H<sub>2</sub>O) for oxidizing Si and a reductant (H<sub>2</sub>) for reducing Ge as claimed.

As for claims 11 and 15, since the oxidation atmosphere that contains H<sub>2</sub>O and H<sub>2</sub> as mentioned above produces the same result as claimed, the partial pressure ratio of H<sub>2</sub>O to H<sub>2</sub> must be inherent within the claimed range, absent evident to the contrary.

4. Claims 17-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art in view of Ast et al. and Bar-Gadda, all cited above.

The admitted prior art of Fig. 26 teaches a method of manufacturing a MOS transistor comprising the steps of:

forming a SiGe monocrystal channel layer including a channel region on a semiconductor substrate;

forming source/drain regions in the SiGe monocrystal channel layer formed on the semiconductor substrate;

forming a gate insulating film on the channel region between the source/drain regions; and

forming a gate electrode on the gate insulating film, wherein the gate insulating film is formed on a surface of the SiGe monocrystal layer by thermally oxidizing the SiGe monocrystal layer.

Note that, although not illustrated in the figure drawing, the admitted prior

art implies the formation of source/drains regions because the MOS transistor must have source/drain regions.

The admitted prior art differs from the claims in that while the admitted prior art forms the gate insulating film by conventional oxidation process that results in a gate oxide film containing SiO<sub>2</sub> and GeO<sub>2</sub>, the claims call for an oxidation process in an atmosphere that contains an oxidant for oxidizing Si and a reductant for reducing Ge so that the gate insulating film is made of substantially silicon oxide.

Ast teaches a process in which a SiGe layer is oxidized in steam such that Si in the SiGe layer is selectively oxidized to form silicon dioxide while Ge in the SiGe layer is not oxidized (col. 5, lines 19-25; col. 6, lines 8-13; col. 4, lines 28-30; col. 8, line 50).

It would have been obvious to one having ordinary skill in the art to modify the admitted prior art by oxidizing the SiGe channel layer in steam as suggested by Ast because the oxidation condition set forth by Ast would produce a gate insulating film contains only SiO<sub>2</sub>. The absence of GeO<sub>2</sub> would prevent damage imposed on the gate insulating film due to the dissolve of GeO<sub>2</sub> in H<sub>2</sub>SO<sub>4</sub> usually used in subsequent process. In addition, Bar-Gadda discloses that steam for use in an oxidation process for producing silicon dioxide is generated by admitting H<sub>2</sub> and O<sub>2</sub> into an oxidation chamber and the H<sub>2</sub> and O<sub>2</sub> react to form steam in close proximity to the semiconductor wafer (col. 2, lines 30-39). In light of the fact shown by Bar-

Gadda, it is therefore believed that H<sub>2</sub> is still present in steam to some extent because not all H<sub>2</sub> takes place in the reaction to form H<sub>2</sub>O. This fact is manifested by the result (silicon is oxidized while germanium is not) obtained in Ast's oxidation atmosphere of steam, which result is identical to that of disclosed in the pending specification. Therefore, absent evident to the contrary, Ast's oxidation atmosphere contains an oxidant (H<sub>2</sub>O) for oxidizing Si and a reductant (H<sub>2</sub>) for reducing Ge as claimed.

As for claim 18, since the oxidation atmosphere that contains H<sub>2</sub>O and H<sub>2</sub> as mentioned above produces the same result as claimed, the partial pressure ratio of H<sub>2</sub>O to H<sub>2</sub> must be inherent within the claimed range, absent evident to the contrary.

### *Claim Rejections - 35 USC § 112*

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 5-9, 12-16, and 19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Independent claim 5 and its dependent claims are indefinite in that claim 5 recites an oxidizing atmosphere contains an oxidant for oxidizing the first semiconductor and the second semiconductor and a reductant for reducing the first



semiconductor and the second semiconductor. However, the specification discloses an oxidant/reductant for oxidizing/reducing **either the first or the second** semiconductor but not both. Furthermore, the limitation regarding the first semiconductor in claim 5 is ambiguous in that the first semiconductor is oxidized by the oxidant to form an oxide film made of the first semiconductor, yet it is also reduced by the reductant. A material cannot be both oxidized and reduced at the same time. Since the limitations of claims 5-9 cannot be understood, a rejection over prior art cannot be made at this time.

For claims 6 and 14, the limitation regarding carbon (C) does not have support from the specification.

For claims 9, 12, 16, and 19, the limitation regarding oxygen (O<sub>2</sub>) does not have support from the specification.

Independent claim 13 and its dependent claims are indefinite in that claim 13 recites at least two kinds of semiconductor. The limitation "at least two" includes three or more. However, the specification discloses silicon and germanium as the only two kinds of semiconductor in conjunction with the corresponding oxidant and reductant. If there were a third kind semiconductor or more, the oxidant(s) and reductant(s) with respect to the third kind semiconductor or more were not defined in the specification.

### ***Drawings***

6. The drawings are objected because Figures 25 and 26 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.121(d)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

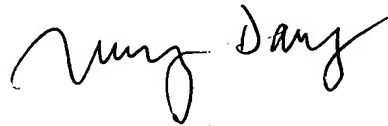
7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Trung Dang whose telephone number is 571-272-1857. The examiner can normally be reached on Mon-Friday 9:30am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Trung Dang  
Primary Examiner  
Art Unit 2823

11/23/04

A handwritten signature in black ink, appearing to read 'Trung Dang', is written over the printed name and title.